Charter for Asteroid Redirect Mission (ARM) Formulation Assessment and Support Team (FAST)

July 22, 2015

Purpose:

The Formulation Assessment and Support Team (FAST) for the Asteroid Redirect Mission (ARM) is chartered by NASA to provide timely inputs for mission requirement formulation in support of the ARM Requirements Closure Technical Interchange Meeting (TIM) planned for mid-December of 2015, to assist in developing an initial list of potential mission investigations, and to provide input on potential hosted payloads and partnerships. To ensure preparedness for beginning formal formulation and development of the ARM, the FAST will focus their inputs on scientific return and knowledge gain from ARM in the areas of science, planetary defense, asteroidal resources and in-situ resource utilization (ISRU), and capability and technology demonstrations.

The Asteroid Redirect Mission:

ARM is part of NASA's plan to advance the new technologies and spaceflight capabilities needed for a human mission to the Martian system in the 2030s, as well as other future human and robotic missions. ARM includes the Asteroid Redirect Robotic Mission (ARRM) and the Asteroid Redirect Crewed Mission (ARCM), along with leveraging the global asteroid-observation community's efforts to detect, track and characterize candidate asteroids. ARRM will be the first robotic mission to visit a large near-Earth asteroid and collect a multi-ton boulder from its surface. The spacecraft will use the multi-ton boulder to perform an enhanced gravity tractor asteroid deflection demonstration and then return it to a stable orbit around the Moon, where astronauts will explore the boulder and return with samples in the mid-2020s during the ARCM. Subsequent human and robotic missions to the returned material could also be facilitated by its availability in cislunar space and would benefit scientific and partnership interests, expanding our knowledge of small celestial bodies and enabling the demonstration of mining asteroid resources for commercial and exploration needs.

The ARRM will utilize an advanced 50 kW-class Solar Electric Propulsion (SEP) spacecraft along with sensors and a robotic Capture Module (CM) to characterize the parent NEA, identify and select candidate boulders, allow contact with the parent NEA, and collect the selected boulder from the surface. Following final restraint of the boulder, the ARRM spacecraft will transfer into halo orbit around the parent NEA and demonstrate the Enhanced Gravity Tractor (EGT) technique, with the collected boulder augmenting the spacecraft mass and thereby greatly increasing the gravitational force between the objects. The instrumentation currently planned includes a sensor suite for high-resolution mapping and characterization during asteroid flybys and extended horizon views for onboard navigation during the descent and planetary defense demonstration phases. The ARRM spacecraft is also planned to provide imagery of the boulder through descent and capture. Limited accommodations for science/payload instrumentation (mass, power, and volume) may also be provided. After the ARRM spacecraft returns to a lunar distant retrograde orbit (LDRO) in the mid 2020s, initial astronaut exploration and sampling of

the returned material will be performed during the ARCM. The capabilities, systems, and operational experience developed and implemented by ARM and subsequent missions to the returned asteroidal material will advance NASA's goal of sending humans to deep-space destinations and eventually to surface of Mars. Currently, the ARRM is planned to be launched at the end of 2020 and the ARCM is planned for late 2025.

The Asteroid Redirect Mission (ARM) and Asteroid Grand Challenge (AGC) together make up NASA's Asteroid Initiative, by which the agency seeks to enhance its ongoing work in the identification and characterization of near-Earth objects for detection of any impact hazard and further scientific investigation. This work includes locating potentially hazardous asteroids and identifying those in viable orbits that allow for redirection of a multi-ton boulder into a stable lunar orbit for future exploration by astronauts. The AGC complements ARM and other asteroid-related activities at NASA in a way that allows the agency to engage the public and leverage interested citizens for science, technology, and planetary defense efforts in support of the challenge to "find all asteroid threats to human populations and know what to do about them."

Please visit http://www.nasa.gov/asteroidinitiative for further details about the ARM and the AGC.

Study Request:

The FAST will work in collaboration with ARM management and technical personnel at the participating field centers to provide input during the requirements definition phase of the ARRM, which includes spacecraft interfaces, requirements, and design considerations as they relate to the ARCM. Additionally, the FAST will assist in developing an initial list of potential mission investigations focused on the following four main areas as they support the robotic and crewed segment objectives: science, planetary defense, asteroidal resources and in-situ resource utilization (ISRU), and capability and technology demonstrations. For example, science investigations could include in-depth characterization of the parent asteroid visited by the mission as well as characterization of the boulder and surrounding regolith. In addition, regolith samples may be acquired during surface operations and investigations of the boulder may be conducted during the return trip and subsequent operations in cislunar space. ISRU investigations could be performed in-situ at the parent NEA or on the boulder during or after its return. The robotic mission includes a demonstration of the EGT technique for planetary defense, but could potentially accommodate other investigations. All ARM investigations will be required to operate within ARRM and ARCM capabilities, as well as programmatic constraints. Justification for including the investigations in baseline ARM operations, including the benefit to NASA and other communities, will be included in the FAST's final report. Finally, the FAST will provide input to NASA on potential hosted payloads and partnerships in coordination with NASA Headquarters and Ames Research Center, which is leading these areas of external cooperation. Limited hosted payloads could include instruments, demonstrations, deployable assets, and experiments related to these four main investigation areas.

Membership:

FAST membership will consist of NASA and non-NASA participants (U.S. citizens and permanent residents) during the period from mid-September through mid-December of 2015. FAST members will be openly solicited and selected by a committee that will include key NASA Headquarters stakeholders, ARM leadership, and others that will be identified. The selected members will have demonstrated expertise and knowledge in areas highly relevant to the ARM primary areas of interest: science, planetary defense, asteroidal resources and in-situ resource utilization (ISRU), and capability and technology demonstrations. Input by members into the FAST process will be gratuitous, with no expectation of compensation.

Structure:

The FAST will be managed by the Mission Investigator and Deputy Investigator who will report findings, along with other FAST members as appropriate, to program and project personnel as required. Participation in the FAST by non-civil service personnel will be limited to providing non-consensus, non-voting input.

Termination:

The ARM FAST will be formally retired following the ARM Requirements Closure TIM, and prior to the Announcement of Opportunity for participation in any follow-on ARM-related activities. Following the completion of the FAST duties, NASA plans to fund an ARM Investigation Team (IT) which will be formed in mid-2016 with a call for membership expected in early 2016. The multidisciplinary IT will assist with the definition and support of investigations in the same four main areas as the FAST. The IT will support ARM program-level and project-level functions, provide technical expertise, and support NASA Headquarters interactions with the technical communities through mission formulation, mission design and vehicle development, and mission implementation.

Meetings:

An initial, in-person meeting of the ARM FAST is planned for mid-September 2015 at a location to be announced. It is planned that the FAST will conduct two or three additional virtual meetings prior to a final, in-person meeting in November 2015 to finalize inputs for the ARRM Requirements Closure TIM. Virtual meetings will typically be one to two days and in-person meeting will be two to three days. Meetings will be called by the ARM Mission Investigator, and the agendas will be set in coordination with NASA management to ensure that planned activities are aligned with programmatic needs and expectations. The meetings will also be supported by key ARM personnel as necessary.

Report:

The final report of the ARM FAST will be submitted to NASA around November 20, 2015. The final report is expected to be released publically and available for comment.

Public Release of Information:

Any public release or discussion of the FAST results of findings, assessments, or studies associated with its functions shall be coordinated with NASA beforehand.

Logistics and Travel:

NASA will provide logistical support for the FAST, including arranging meetings, compiling agendas, issuing minutes, and compiling and editing the final report. NASA plans to offer invitational travel, at NASA's expense, to members asked by NASA to travel to FAST meetings, subject to NASA policies and availability of funds.

Point-of-Contact:

The NASA point-of-contact and Mission Investigator for ARM is Mr. Dan Mazanek (Daniel.D.Mazanek@nasa.gov)

Michele M. Gates, Ph.D.
Program Director, Asteroid Redirect Mission
NASA Headquarters